We Claim:

1. An apparatus for processing color images, comprising:

an input processor, wherein an image is received;

a Retinex-type processor, comprising:

a local statistics processor, comprising a cascaded recursive filter, and

a point operation processor correcting pixels of the input image according to corresponding pixel values in the local statistics processor; and

an output processor.

2. The apparatus of claim 1, wherein the cascaded recursive filter is a cascade of filters of the form:

$$L_{i,j}^{SE} = \max\{\alpha(\nabla_x S)\cdot L_{i-1,j} + (1-\alpha(\nabla_x S))\cdot S_{i,j},\ \alpha(\nabla_y S)\cdot L_{i,j-1} + (1-\alpha(\nabla_y S))\cdot S_{i,j},\ \ S_i\},$$

whereby SE above may be replaced by one of N, S, E, W, NE, NW, or SW according to standard compass notations corresponding to a direction of information flow.

3. The apparatus of claim 2, wherein a parameter α of the cascaded recursive filter is a function of an input signal of the image.

4. The apparatus of claim 3, wherein the parameter α is a function of a local gradient ∇S, which returns a constant value α_0 for large ∇S values and decreases monotonically to zero as ∇S decreases.

5. The apparatus of claim 4, wherein $\alpha(\nabla S)$ is scale independent.

6. The apparatus of claim 5, wherein,

$$\alpha(\nabla S, \nabla_N S, N) = \begin{cases} \sqrt[N]{\alpha_0^{N_0}} & \nabla_N S \geq -T \\ \sqrt[N]{\alpha_0^{N_0}} \cdot e^{\beta\cdot\min\{\nabla S, 0\}} & \nabla_N S < -T \end{cases},$$

wherein N is a size of the input image S, wherein $\nabla_N S$ is a scaled gradient, wherein T is a threshold value, and wherein β is a constant parameter.

7. The apparatus of claim 6, wherein the scaled gradient of the image is

$$\nabla_N S = \sum_{i=\Delta_N^- +1}^{\Delta_N^+} |S(i+j) - S(i+j-1)|.$$

8. The apparatus of claim 1, further comprising an open/close prefilter, and a maximum with the input image as a post processor.

9. The apparatus of claim 8, wherein a scaled gradient of the image is

$$\nabla_N S = S\left(i + \Delta_N^+\right) - S\left(i - \Delta_N^-\right)$$

where $\Delta_N^+ + \Delta_N^- = \left\lfloor N/N_0 \right\rfloor$, and $\Delta_N^+ + 1 \geq \Delta_N^- \geq \Delta_N^+$. 2

10. A robust recursive envelope operator for fast Retinex processing, comprising:

a cascaded recursive filter, comprising:

$$\begin{aligned} L_{i,j}^{xx} = \max\{&\alpha(\nabla_x S) \cdot L_{i-1,j} + (1 - \alpha(\nabla_x S)) \cdot S_{i,j}, \\ &\alpha(\nabla_y S) \cdot L_{i,j-1} + (1 - \alpha(\nabla_y S)) \cdot S_{i,j}, \quad S_i\}, \end{aligned}$$

wherein α (∇S) comprises a scale independent parameter, wherein xx comprises a compass notation, and wherein the robust recursive envelope operator processes an input image signal S.

11. The robust recursive envelope operator of claim 10, wherein α is a function of the input image S.

12. The robust recursive envelope operator of claim 11, wherein the function is a Huber function.

13. The robust recursive envelope operator of claim 10, wherein α is a function of one or more parameters,

$$\alpha(\nabla S, \nabla_N S, N) = \begin{cases} \sqrt[N]{\alpha_0^{N_0}} & \nabla_N S \geq -T \\ \sqrt[N]{\alpha_0^{N_0}} \cdot e^{\beta \cdot \min\{\nabla S, 0\}} & \nabla_N S < -T \end{cases},$$

wherein N is a size of the input image S, wherein $\nabla_N S$ is a scaled gradient, wherein T is a threshold value, and wherein β is a constant parameter.

14. The robust recursive envelope operator of claim 10, wherein the compass notation is one or more of SE, SW, NE, NW, and wherein application of the cascaded recursive filter follows the compass notations.

15. A method for processing an input image S, comprising:

applying an open/close prefilter to the image S; 3

applying a cascaded recursive filter to the image S; and

applying a post filter maximum output to the image S.

16. The method of claim 15, wherein the cascaded recursive filter is of the form:

$$L_{i,j}^{SE} = \max\{\alpha(\nabla_x S)\cdot L_{i-1,j} + (1-\alpha(\nabla_x S))\cdot S_{i,j},\ \alpha(\nabla_y S)\cdot L_{i,j-1} + (1-\alpha(\nabla_y S))\cdot S_{i,j},\ \ S_i\}.$$

17. The method of claim 16, wherein a parameter α of the cascaded recursive filter is a function of an input signal of the image.

18. The method of claim 17, wherein the parameter α is a function of a local gradient ∇S which returns a constant value α_0 for large ∇S values and decreases monotonically to 0 as ∇S decreases.

19. The method of claim 16, wherein α (∇S) is scale independent.

20. The method of claim 19, wherein

$$\alpha(\nabla S, \nabla_N S, N) = \begin{cases} \sqrt[N]{\alpha_0^{N_0}} & \nabla_N S \geq -T \\ \sqrt[N]{\alpha_0^{N_0}} \cdot e^{\beta\cdot\min\{\nabla S,0\}} & \nabla_N S \langle -T \end{cases},$$

wherein N is a size of the input image S, wherein $\nabla_N S$ is a scaled gradient, wherein T is a threshold value, and wherein β is a constant parameter.

21. The method of claim 20, wherein N_o equals 256.

22. The method of claim 20, wherein applying the cascaded filter comprises sequentially applying the cascaded filter following a compass notation.

23. The method of claim 22, wherein the sequential application comprises SE, SW, NW, NE.

24. The method of claim 22, wherein the sequential application comprises more than four filters in cascade, including SE, NW, SW, NE, SE, NW.